THE BIOLOGICAL DIVERSITY AND AQUACULTURE OF CLARIID AND PANGASIID CATFISHES IN SOUTH-EAST ASIA

Proceedings of the mid-term workshop of the
"Catfish Asia Project"
Cantho, Vietnam, 11-15 May 1998

Edited by :
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INTEREST OF BASIC AND APPLIED RESEARCH ON *PANGASIUS* SPP. FOR AQUACULTURE IN THE MEKONG DELTA: SITUATION AND PROSPECTS

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Abstract

Aquaculture of the Mekong catfish, *Pangasius* spp., is of major economic interest in the Mekong Delta in Vietnam. The culture of this fish has always been depending on collecting fry and fingerling in the wild, mainly upwards the Mekong River in Cambodia. A collaborative research programme has led, for the first time, to the artificial reproduction of *Pangasius bocourti* and the biotechnical process has been extended to other species of *Pangasius*. This work opens many doors both in terms of research and of development which are described in this paper.

WHY WORKING ON PANGASIUS?

A few words of history

The first glance at *Pangasius* aquaculture in Vietnam took place in November 1992 when the promoters of the "Catfish Asia" Project (Lazard & Legendre, 1993) came on mission to Ho Chi Minh City where they met the scientists of the University of Agriculture and Forestry (UAF) of Thu Duc, to Can Tho City at University of Can Tho and to Chau Doc where they met the staff of AFIEX (now, AGIFISH).

They felt totally amazed facing such a level of development in *Pangasius* floating cage and pond production. The first step was to propose to the Vietnamese partners from UAF to carry out diagnostic studies on both these *Pangasius* production systems (Cacot, 1994; Peignen, 1993) with an additional one on aquaculture in man-made lakes (Bazir, 1994). All these studies took place in 1993 and were conducted by teams mixing Vietnamese and French graduating students.

This was the real starting point of the "Catfish Asia Project", as far as the Vietnamese component is concerned. The assessment on the *Pangasius* culture sector pointed out clearly that the main bottleneck for *Pangasius* culture large scale development was the lack of artificial reproduction/controlled propagation of this fish for supplying the Mekong catfish farmers.

Situation of Pangasius *fry and fingerlings supply for aquaculture*

- In the Mekong Delta, the aquaculture production of *Pangasius* exceeds significantly the production from capture fisheries, showing the economical importance of aquaculture in the global fisheries sector.
- Fry and fingerlings of both cultured *Pangasius* species (*P. bocourti* and *P. hypophthalmus*) come totally from the wild (estimation: 80% from Cambodia and 20% from Vietnam for *Pangasius bocourti*). About 20 to 25 millions of fingerlings pieces of each species are estimated to be required for culture purposes, both in cages and in ponds.
- The expenses for cage production show that more 50% (even much more, depending on the year) is due to fingerlings costs.

MOTIVATIONS OF RESEARCH WORK ON *PANGASIUS*

First of all, the main motivation for carrying out research work on *Pangasius* spp. in the Mekong Delta aims at studying biological bases on autochthonous fish, then enhancing the use of local biodiversity.

Entering more into details, motivations of this work are, among others, as follows.

Generally speaking, it can be assessed that only **a few basic and applied researches** has been conducted on *Pangasius* spp and particularly in Vietnam where, nevertheless, Mekong Catfish is of major economic value. In Vietnam, only *Pangasius sutchi* (now *P. hypophthalmus*) has been studied and only 5 references have been reported through the various bibliographic databases as to July 1997 (Table 1). The main research works carried out on *Pangasius* reproduction and genetics are summarised briefly in Table 2.

- **Taxonomy** among the *Pangasius* genus was until recently a mess. As an example, when the French-Vietnamese collaborative research programme on artificial propagation started in 1994, *Pangasius bocourti* was still denominated *P. pangasius* and *P. hypophthalmus* was known as *P. micronema* (Roberts & Vidthayanon, 1991). And most probably, there remains a lot to be done in this field.
- As **no artificial reproduction** techniques were available on these species cultured in Vietnam, the demand for basic and applied research in this field was very strong, both from the scientists (University of Can Tho) and the farmers (AGIFISH).
- **Species diversification** is one of the main requests from the fish farmers. The fish farmers are probably, among the population of farmers around the world, those who are the most in the process of seeking diversification of cultured species for better income and benefits. This explains probably why all the fish farmers are more or less somewhat scientists and why research work in this field is, in the same time, so difficult and motivating. Diversification of species appears to be a priority for *Pangasius* farmers in Vietnam.

REPRODUCTION
- **induced spawning (mainly on *P. sutchi*)**
- **sperm preservation**
- **incubation methods/techniques**
- **embryonic development**
- **morphological study of gonads**

GENETICS
- **caryotype study**
- **heritability of some morphological characters**
- **hybridisation**
  - ***P. sutchi* x *C. batrachus*** } → **hybrids**
    x *C. macrocephalus* }
  - ***C. macrocephalus* x irradiated sperm *P. sutchi*** → **gynogenetic *C. macrocephalus***

Table 2: Main research works carried out on *Pangasius* reproduction and genetics.

STATUS OF RESEARCH ON *PANGASIUS* IN THE MEKONG DELTA IN 1998

The research programme which is carried out since about 4 years already led to very significant results which can be summarised as follows. These

Countries	Systematic	Wild populations and fishing	Biology	Reproduction	Genetics	Culture techniques	Nutrition	Pathology	Total
Bangladesh	1	3	3						**9**
China	2		1	1		3			**5**
India		2	1		1	1			**4**
Indonesia	1	1	2	1				1	**8**
Laos		1				2			**1**
Malaysia	1	1		3			5	2	**12**
Thailand	1	1	5	12	6	8	4	5	**42**
Vietnam				1		2		2	**5**
Indochina Peninsula	1					1			**2**
South-east Asia						1			**1**
World	1					1			**2**
Undetermined	1		6					1	**8**
Total	**9**	**9**	**17**	**18**	**7**	**19**	**9**	**11**	**99**

Table 1: Status of scientific and technical references on *Pangasius* from the various databases: CAB, AGRIS, BIOSIS, ASFA, PASCAL, AGRICOLA (15.07.1997).

significant results are due to the fact that the opportunity was given to conduct experimentation both in ponds at Can Tho University and in floating cages in Chau Doc.

Reproduction in captivity

This work started in 1994 and the first artificial reproduction of *P. bocourti* in the world took place in Can Tho University in May 1995. The bio-technical process developed on this species was extended to *P. hypophthalmus* and to inter-specific hybrids (Cacot *et al.*, in preparation).

AGIFISH company, which closely participated to this experimental work, was able to produce several millions of fry of *Pangasius* spp. in 1997 within its new built hatchery in Chau Doc: 3 000 000 pieces of *P. hypophthalmus*, 1 000 000 pieces of hybrid *P. hypophthalmus* female x *P. bocourti* male and 400 000 pieces of *P. bocourti*.

Fry and fingerling nursing

The work on fry and fingerling was only made possible due to availability of fry in large quantities and started in 1996. If the main problems related to *P. bocourti* larval rearing seem to be solved with satisfying survival rates (Hung *et al.*, in press), it is still not the case for *P. hypophthalmus* which requires additional research work on feeding related to its cannibalistic behaviour and its need for feeding on live preys.

Taxonomy

Even if now, things seem to be approximately clear about the taxonomy of *Pangasius* species and particularly in the Mekong Delta, investigations in this field are still required in order to answer remaining questions about the occurrence of questionable species (*P. djambal* for example).

"New" species for aquaculture

There is no doubt that, in the future, other species of *Pangasius* will be cultured by fish farmers and this trend towards a species diversification will be boosted thanks to the artificial reproduction control.

Table 3 gives the main characteristics of the *Pangasius* species of potential interest for aquaculture found in the Mekong Delta.

Special emphasis should be put on hybrids which can be considered as "new" species.

Following the successful reproduction in captivity and the reliable technique developed, *Pangasius* hybrids have started to be produced on quite a large scale in Vietnam in the AGIFISH Chau Doc hatchery. Many fish hybrids are already used on a large scale for aquaculture purposes around the world (Table 4). Nevertheless, the potential of pure species has to be carefully assessed before starting hybridisation programmes

Scientific name	Vietnamese name(s)	Growth (scale from 1 to 5)	Robustness (scale from 1 to 4)	Fat (scale from 1 to 3)	Market Value (scale from 1 to 3) ( ) : interest for processing +fat ; ++non fat	REMARKS
P. bocourti	ca ba sa	3	2	3	2 (++)	
P. conchophilus	ca hu	2	3	2	1 (+)	
P. djambal (?)	ca bong lau* ca tra ban	3	3	1	2 (+)	
P. hypophthalmus	ca tra	5	4	1	1 (+)	not a good reputation (latrine ponds)
P. larnaudii	ca vo dem	4	1	3	2 (++)	strong pathologic problems in culture
P. macronema	ca xac soc	1	no data	1	1	NO INTEREST FOR AQUACULTURE low growth rate, low price, no potential for processing
P. micronema	?	1	no data	?	no data	
P. polyuranodon	ca dua	1	no data	1	1	
P. sanitwongsei	ca vo co	5	no data	2	no data (+)	ggressiveness in captivity
P. krempfi	ca bong lau*	NO CULTURE IN CAGES MAINLY BECAUSE NO GOOD SURVIVAL WHEN MANIPULATIONS/HANDLING			3 (+)	THE BEST FOR BRACKISH WATER CULTURE

* commercial name (used on markets and Long Xuyen factory).

Table 3: Main characteristics of *Pangasius* species of Mekong Delta for aquaculture (from Lenormand, 1996).

because the large scale artificial production of hybrids is not without risk for the environment and, moreover, could have very harmful impacts on natural populations (Table 5).

PROSPECTS FOR RESEARCH AND DEVELOPMENT IN *PANGASIUS* AQUACULTURE IN THE MEKONG DELTA

All the work already done on *Pangasius* aquaculture in the Mekong Delta in a very short time (4 years) opens very numerous gates for the future, both in terms of research and in terms of development.

Research

The main research topics in the field of *Pangasius* aquaculture in the next future appear to be the following ones.

Species hybridised	Effect/Advantage and Comments	Reference
Ctenopharyngodon idella x *Aristichthys nobilis*	Sterile – Natural triploïds	Allen & Wallendorf, 1987
Misgurnus mizolepis x *M. anguillicandatus*	High hatch and survival Probably fertile	Kim *et al.*, 1995
Hypophthalmichthys molitrix x *Aristichthys nobilis*	Fertile + positive heterosis for growth rate Food and feeding strategies intermediate to parents	Krasnai, 1987
Cyprinus carpio x *Labeo rohita* x *Cirrhinus mrigala* x *Catla catla*	Sterile, good growth in monoculture and survival, good seinability Tetraploid carps x diploid cyprinids → triploids Many deformities and high juvenile and larval mortality	Khan *et al.*, 1990
Oreochromis spp. crosses	- all male offspring - cold tolerance - salinity tolerance - colour (red tilapia)	many authors !!
Colossoma macropomum x *Piaractus mesopotamicus* x *P. brachypoma*	Good growth rate and good early survival probably fertile	FAO, unpublished Senhorini *et al.* 1988
Clarias gariepinus x *Clarias macrocephalus*	Superior flesh and growth characters Artificial spawning induction/fertilisation required	Suresh, 1991
Clarias gariepinus x *Heterobranchus longifilis*	Fertile F1 and F2 hybrids and back crosses	Nwadukwe, 1995
C. gariepinus x *Heterobranchus bidorsalis*	Positive heterosis for growth rate and size	Salami *et al.*, 1993

Table 4: Some examples of fish hybrids used in aquaculture as reported by FAO 1997).

Pangasius hypophthalmus ♀ x *Pangasius bocourti* ♂ (1995)

Fecundity: >> *P. bocourti*

- Quality of flesh: good for processing (Agifish) > *P. bocourti* ?
- Growth rate ⎫ to be assessed accurately and compared
- Food conversion ratio ⎭ with the pure parental strains
- Fertility of hybrids: ?
- If fertile: F_1, F_2... F_n
  - backcrosses with parents
  - selection breeding programme possible
  - **DANGER**: crosses of escaped hybrids in the wild if crosses with natural populations possible

MAXIMUM CARE OF CULTURE CONDITIONS (hatchery, ponds, cages) HAS TO BE TAKEN

Table 5: Some considerations on *Pangasius* hybrid(s).

- *Optimisation of reproduction in captivity*
  - broodstock management aiming at increasing the quality of gametes, eggs and larvae;
  - ovulation treatments diversification and fertilisation and eggs incubation practices optimisation;
  - fecundity of *P. bocourti* increase by several means: broodstock management (particularly by improving the nutrition practices in terms of quality and quantity) and increasing the number of spawning around the year ;
  - extending upwards and downwards in the time the reproduction period.
- *Fry and fingerling production*
  - larvae and fry management for reducing cannibalism and mortality rate in *P. hypophthalmus* (including antibiotic treatment trials);
  - larvae and fry feeding optimisation (live and artificial feed) in different rearing environments and systems (tanks, aquaria, ponds, hapas,...).
- *Feeding practices for market size* Pangasius *production*
  - improving the traditional feeding practices of *Pangasius* spp cultured in floating cages.
- *Pathology*
  - considering globally the pathologic aspects of *Pangasius* culture the approach in this field should include several items from culture practices (eco-pathology) to chemical treatment trials.

Development

The results obtained in the framework of the "Catfish Asia" Research Project should be transferred to the producers at two levels:

- Large-scale level: this transfer is already going on with AGIFISH, one among the main producers of *Pangasius* in floating cages in Chau Doc and the main processing factories manager (Long Xuyen).
- Small-scale level: the transfer of artificial reproduction of *Pangasius* and mass fry production could be conducted, after a careful pilot scale technology verifying step, by institutions such as Can Tho University.

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